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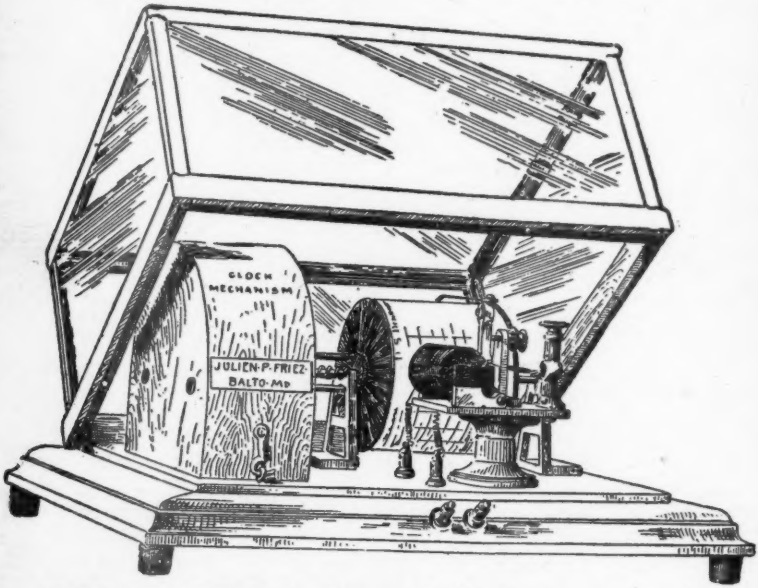

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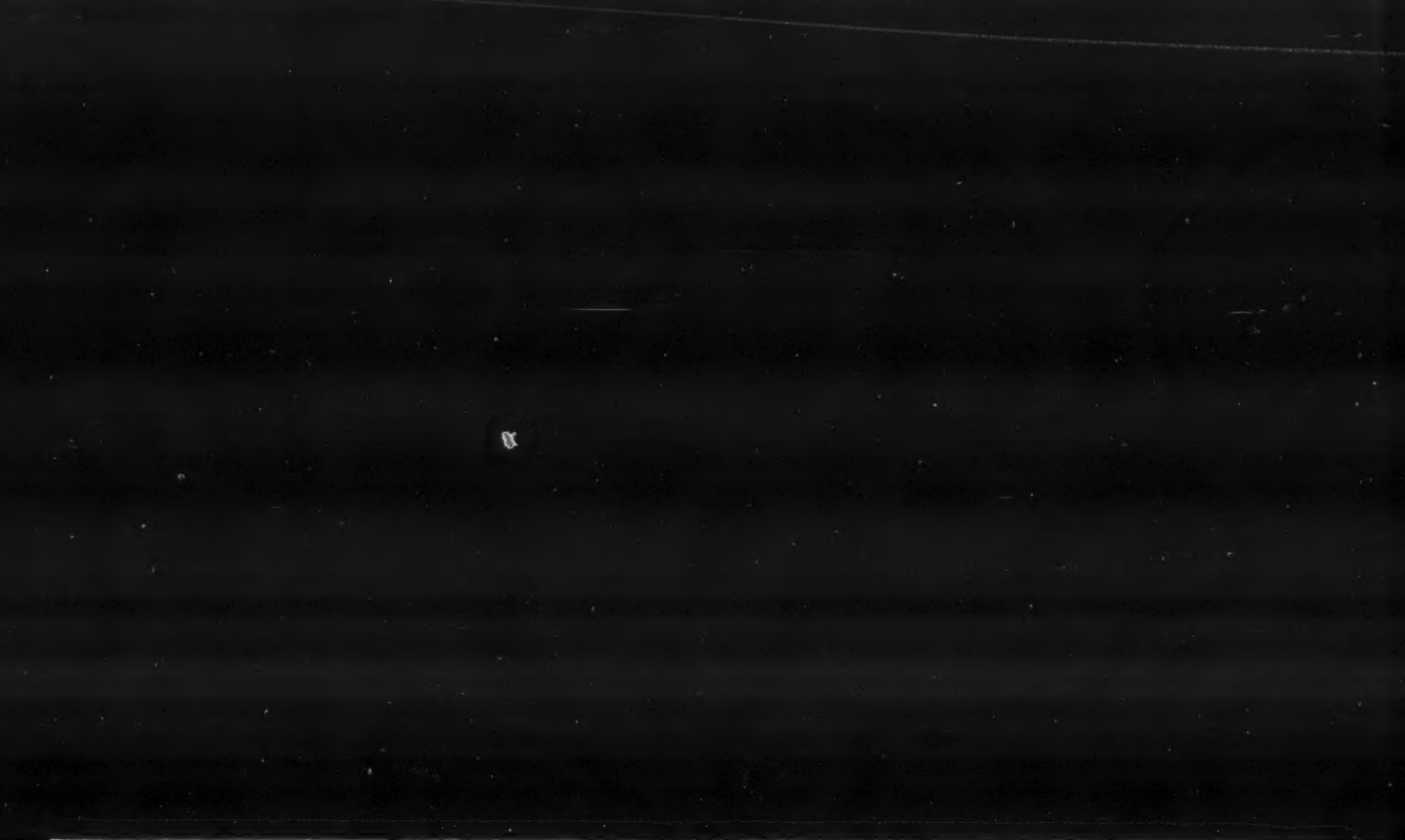

THE AMERICAN

METEOROLOGICAL JOURNAL.

VOL. XI. BOSTON, MASS., NOVEMBER, 1894. No. 7.

CYCLONIC PRECIPITATION IN NEW ENGLAND.

PROF. WINSLOW UPTON.

IT is now ten years since the formation of the New England Meteorological Society. One of the purposes for which it was founded was to discuss the various data which have been collected by the industry of observers in the several New England States. Soon after the organization of the Society, it seemed to the writer that in the current reports of the observers, as well as those made for special purposes, there must be involved facts of interest, which would appear if the observations were discussed. The ordinary observations were limited to precipitation and temperature, made with ordinary rain gauges and thermometers, but the stations were numerous in Southern New England, at least sufficiently so to warrant the hope that the time spent in examining the reports might not be wasted. The problem decided on was the Distribution of Precipitation in Cyclones, and the method of treatment was by tabulation of the reports, in order to discover what peculiarities were involved in the distribution, and whether they were due to topography or were incident to the storm itself.

With the aid of a grant from the trustees of the Elizabeth Thompson Science Fund, the needed clerical assistance was obtained and a preliminary study made of the cyclones which had passed near New England for the nineteen months, January, 1885, to July, 1886. The results obtained were embodied in a series of articles published in this JOURNAL in the issues for October, November, December, 1886, and January, 1887. The conclusions reached were necessarily tentative, but seemed to be sufficiently plausible to warrant further study when more data should have accumulated. The trustees of the Elizabeth

Thompson Science Fund generously voted an additional grant for clerical aid, and to them the writer wishes to return thanks for their assistance, without which this study would not have been made.

The larger part of this second appropriation was devoted to a study of the "Great Blizzard" of March, 1888, which was published in this JOURNAL for May, 1888. The present paper continues the discussion of the ordinary cyclones from August, 1886, to December, 1892, beyond which it seems hardly wise to continue the study on the plan adopted.

The preliminary discussion led to a number of conclusions from which the following were selected for confirmation or overthrow:—*

"(1.) The maximum area of precipitation in the northern group of cyclones which entered New England from the west, lies *south* of their path at an average distance of about one hundred miles; in the corresponding southern group it lies *north* of their path at an average distance of about one hundred and fifty miles.

"(2.) The maximum area of precipitation in those cyclones which moved north of New England lies about three hundred miles south of their path, in Central Massachusetts. This may be a secondary maximum of this group of cyclones.

"(3.) The maximum area of precipitation in those cyclones which entered New England from the south, lies approximately along their path.

. . . . . .

"4. The direction in which the rain front and rear advance is not always the same as that of the centre of the cyclone. The deviation is more marked in those which enter New England from the west than in those from the south, especially in the summer when the rain is in connection with thundershowers. The rate of movement is also markedly different. In the western group the rate is sometimes greater, sometimes less than that of the cyclone; in the southern group it is uniformly less."

The groups referred to in the above paragraph resulted from the classification adopted in the tabulation of the reports. The

* American Meteorological Journal, January, 1887, page 416.

cyclones were divided into two main divisions, according to the direction from which they approached New England, whether from the west or south, and each of these into two sub-divisions, according to the track of the central depression, whether it moved across New England or simply near enough to its borders to dominate the weather for a time. A third main division included all peculiar cases, such as cyclones which formed or broke up near New England, double cyclones whether uniting or keeping in separate paths. This division has been maintained in the present discussion, as it is largely a natural division. There are very few cyclones passing near New England which do not at once readily fall into one of the two classes, and the characteristics of the two classes are somewhat different. The cyclones which visit New England from the west usually come from the Lakes and either move down the St. Lawrence valley to the ocean, or take the shorter route from Lake Ontario across New England to Massachusetts Bay. Those which reach New England from the south (or southwest) either come up the coast from tropical regions, or are formed off the east Atlantic coast. The southern storms are usually more violent and deposit a greater amount of rain or snow than those which come from the Lakes.

The method of study was the same as that of the earlier investigation. A list of cyclones was made out, including nearly all in which the precipitation had been general over New England. The amounts reported by the several observers were then entered upon maps, and the distribution noted with regard to the track of the minimum pressure. Similar maps were constructed for the times of the beginning and ending of the precipitation as far as such data were available. The reports of all observers were used until January, 1889, making four years in all. Beginning with that date the table published in the bulletin of the Society, entitled "Daily Precipitation at Selected Stations," was used until its discontinuance in December, 1892. The times of beginning and ending of precipitation were not used for the latter period of four years. The total number of cyclones thus examined aggregates 212 for the seventy-seven months, August, 1886, to December, 1892. Adding the results of the preliminary study which was based on 41 cyclones, we have a total of 253 on which the following discussion rests.

It may be noted in passing that the storms selected can be fairly regarded as typical of all the cyclones which visit New England, though no attempt was made to make the number of any one group accord with the proportion which would be obtained had every cyclone been included in the list. Those in which the precipitation was general over New England and of a quantity exceeding 0.25 inch were alone used. The 212 cyclones included 153 from the west, 40 from the south, and 19 peculiar cases. The average proportion for five years, 1888–1892, is 70 per cent for the western, and 17 for the southern group.* The figures above give 72 and 19 per cent respectively.

It is not necessary to describe each storm in detail, but a tabular view will give concisely all the data from which conclusions are to be later derived. In the following tables the cyclones are first grouped into the two general classes, and each of these into its two subclasses. The pressure is given in inches and tenths, and is simply an approximate estimate of the minimum pressure of the cyclone when passing New England. If the pressure was increasing or diminishing as the cyclone passed by, the letter *i* or *d* is added. The maximum amount of precipitation is the average of several adjacent reports (usually three) in order to indicate the maximum over a considerable area without exaggeration. The data for the paths of the cyclones and their velocity while passing New England were obtained from the current maps of the United States Signal Service or the "Monthly Weather Review."

CLASS I.

Storms passing over or near New England from the West.

The following tables give in a concise form the data bearing upon the character of each cyclone, and also the position of the area of maximum precipitation with reference to the path of the centre of the depression. The numbering is continued from that of the earlier study above referred to, the first cyclone numbered 42, and the tables numbered XIII. and XIV.

* Annual summary of the New England Weather Service for 1892. Annals of the Astronomical Observatory of Harvard College, XLI., Part I.

TABLE XIII.

CYCLONES WHICH MOVED FROM THE WEST ACROSS NEW ENGLAND.

No.	Date of Passage.	Pressure at Centre. (Inches.)	Hourly Velocity. (Miles.)	PRECIPITATION.			
				Kind.	Maximum Area.		
					Amount. (Inches.)	Distance from Path. (Miles.)	Direction from Path.
42	Aug. 17, 1886	29.6d	50	Rain.	1.8	40	N.
43	Nov. 7, "	29.2d	25	Rain and Snow.	2.0	80	SE.
44	Dec. 2, "	29.4d	30	Rain and Snow.	1.2	0	-
45	Dec. 18, "	29.8d	55	Rain and Snow.	1.5	160	SE.
46	Jan. 10, 1887	29.5d	45	Rain and Snow.	0.7	50	S.
47	Jan. 24, "	29.4d	30	Rain and Snow.	1.8	200	S.
48	Feb. 11, "	29.2d	50	Rain.	0.8	100	N.
49	Feb. 24, "	29.2d	40	Rain and Snow.	1.1	300	S.
50	Feb. 27, "	29.0i	45	Rain and Snow.	1.3	225	S.
51	March 25, "	29.2d	45	Rain and Snow.	0.5	200	SE.
52	March 28, "	29.2d	30	Rain and Snow.	2.0	150	S.
53	April 29, "	29.1i	20	Rain and Snow.	4.0	0	-
54	July 18, "	29.8i	25	Rain.	3.0	0	-
55	Aug. 12, "	29.7	20	Rain.	1.6	140	SW.
56	Aug. 18, "	29.5d	35	Rain.	4.0	80	SE.
57	Oct. 5, "	29.6i	25	Rain.	0.6	40	N.
58	Nov. 10, "	29.1	60	Rain.	1.5	0	-
59	Dec. 28, "	29.2d	40	Rain and Snow.	2.5	170	S.
60	Jan. 18, 1888	29.7d	45	Snow.	1.5	0	—
61	Jan. 26, "	29.0d	15	Rain and Snow.	2.5	100	N.
62	Feb. 5, "	29.6d	55	Rain and Snow.	1.3	180	SSE.
63	March 21, "	29.3i	30	Rain and Snow.	2.3	200	S.
64	April 2, "	29.5d	60	Rain and Snow.	1.3	50	SE.
65	April 6, "	29.7i	40	Rain and Snow.	1.0	150	SE.
66	April 11, "	29.9i	30	Rain and Snow.	1.1	200	SW.
67	April 14, "	29.8i	25	Rain and Snow.	0.2	80	NNE.
68	June 25, "	29.7	20	Rain.	2.8	90	SE.
69	July 11, "	29.3d	20	Rain.	1.5	0	—
70	Aug. 4, "	29.7	15	Rain.	1.5	320	SW.
71	Aug. 13, "	29.9d	15	Rain.	4.0	50	NW.
72	Oct. 2, "	29.5i	20	Rain.	1.2	50	S.
73	Oct. 7, 1888	29.4i	15	Rain.	3.0	60	SE.
74	Oct. 17, "	29.9d	35	Rain.	0.6	100	SW.
75	Nov. 19, "	30.0d	40	Rain and Snow.	0.8	0	—
76	Feb. 6, 1889	29.2d	20	Rain and Snow.	1.6	100	S.
77	Feb. 9, "	29.9	60	Snow.	0.5	240	S.
78	July 19, "	29.7	15	Rain.	2.2	110	S.
79	Aug. 15, "	29.7i	35	Rain.	2.7	70	NW.
80	Oct. 6, "	29.9d	15	Rain.	2.4	180	N.
81	Dec. 11, "	29.7d	35	Rain.	1.4	0	—
82	Jan. 16, 1890	29.6d	30	Rain and Snow.	1.6	100	S.
83	Jan. 20, "	29.4	55	Rain.	0.6	40	SW.
84	Jan. 24, "	30.0	55	Snow.	1.8	40	SSW.
85	Jan. 27, "	29.7	45	Rain and Snow.	0.7	60	NE.
86	April 4, "	29.5d	35	Rain.	1.2	240	S.
87	May 20, "	29.7d	40	Rain.	2.2	60	ESE.

TABLE XIII. *(Continued.)*

1	2	3	4	5	6	7	8
88	Aug. 27, 1890	29.5d	35	Rain.	3.0	100	NW.
89	Aug. 30, "	29.7i	15	Rain.	1.5	80	SSE.
90	Oct. 4, "	29.7d	30	Rain.	2.5	300	SW.
91	Jan. 12, 1891	28.7	35	Rain and Snow.	2.3	50	SE.
92	Jan. 22, "	29.2	35	Rain.	2.3	120	SE.
93	Jan. 27, "	30.1	35	Snow.	0.8	50	S.
94	Feb. 3, "	29.3d	35	Snow.	1.0	170	SE.
95	April 15, "	30.0	50	Rain.	1.0	40	SSE.
96	Aug. 15, "	30.0	20	Rain.	1.8	150	N.
97	Oct. 26, "	29.7d	40	Rain and Snow.	0.5	230	SW.
98	Dec. 7, "	29.6d	60	Rain and Snow.	0.8	130	SSE.
99	Dec. 16, "	29.2d	35	Rain and Snow.	1.4	140	SE.
100	Dec. 30, "	29.6d	25	Rain and Snow.	2.6	120	NW.
101	Jan. 2, 1892	29.4i	15	Rain and Snow.	2.0	0	—
102	Feb. 3, "	29.7	30	Rain and Snow.	1.2	20	S.
103	Feb. 11, 1892	29.1d	45	Rain and Snow.	1.6	20	S.
104	Feb. 15, "	28.6i	40	Rain and Snow.	0.5	100	SE.
105	May 11, "	29.7	30	Rain.	1.3	30	N.
106	Aug. 25, "	29.8i	20	Rain.	4.5	160	NE.
107	Sept. 5, "	29.8d	30	Rain.	1.0	320	S.
108	Oct. 3, "	29.5	35	Rain.	2.0	140	SSW.
109	Oct. 8, "	29.7d	35	Rain.	0.4	70	SW.
110	Oct. 29, "	29.6i	30	Rain.	0.5	0	–

NOTES.

The following notes state concisely the path of each storm while crossing New England, together with other facts pertinent to this discussion: —

42. Moved easterly across southern Vermont and New Hampshire, attended by local thunderstorms.

43. Formed in Virginia, moved northeasterly across western Massachusetts, southeastern New Hampshire, and Maine.

44. Crossed central Vermont and New Hampshire in a southeasterly direction, thence northeasterly across southern Maine.

45. Moved northeasterly near the northwestern boundary of Vermont.

46. Moved easterly across northern Vermont, New Hampshire, and southwestern Maine.

47. Passed north of Vermont and New Hampshire and southeasterly across eastern Maine.

48. Crossed Massachusetts in an east-northeasterly direction.

49. Passed north of Vermont and crossed the extreme northern part of New Hampshire and over central Maine.

50. Moved easterly across northern Vermont, New Hampshire and central Maine.

51. Crossed the northwestern corner of Vermont, moving northeasterly. The precipitation was very light for so severe a cyclone.

52. Moved easterly across northern Vermont, New Hampshire, and central Maine.

53. Entered northwestern Massachusetts from New York, moved south-

easterly across western Massachusetts, northeastern Connecticut, then curved in southern Rhode Island and the southeastern shore of Massachusetts, moved northerly in Massachusetts Bay, and again crossed New England continuing northerly in southwestern Maine. A maximum area of two inches precipitation was noted in central Massachusetts, fifty miles northeast of the path, and another maximum of four inches in western Maine near the path after its turn northward.

54. Crossed Massachusetts and eastern Connecticut moving southeasterly, and continuing south, turned somewhat towards the *west* to Virginia, whence it continued easterly to the ocean.

55. Crossed central Maine, moving southeasterly.

56. Moved northeasterly across southern Vermont, central New Hampshire, and central Maine.

57. Moved southeasterly across southern Vermont and New Hampshire.

58. Crossed Massachusetts and Rhode Island southeasterly, then curved to the northeast, and passed along the Maine coast.

59. Moved easterly along the northern boundary of Vermont and New Hampshire, and northeasterly in northern Maine.

60. Moved southeasterly across southwestern Vermont and Massachusetts, thence northeasterly along Nova Scotia, greatly increasing in energy.

61. Moved easterly across Massachusetts.

62. Moved northeasterly across northern Vermont and New Hampshire and central Maine.

63. Moved from Montreal southeasterly across Vermont and New Hampshire to southwestern Maine, thence northeasterly across Maine. This cyclone was remarkable for the numerous changes in its direction in its journey across the United States.

64. Moved northeasterly across northern Vermont and New Hampshire and western Maine.

65. Moved easterly across central Vermont, New Hampshire, and western Maine.

66. Moved southeasterly across northeastern Vermont, northern New Hampshire, and southwestern Maine.

67. Passed across southern Massachusetts and northern Rhode Island. Precipitation was very light, but the maximum area is well defined north of path.

68. Crossed northwestern Vermont, moving northeasterly, then curved to southeast over central Maine, and moved easterly into the ocean. The rain was in local thunderstorms on several successive days.

69. Crossed northern New Hampshire and southwestern Maine, moving southeasterly.

70. Crossed southwestern Maine, moving southeasterly.

71. Moved northeasterly across northwestern Connecticut, central Massachusetts, and along the Maine coast.

72. Crossed central Vermont, New Hampshire, and southwestern Maine, moving easterly.

73. Moved northeasterly over central Massachusetts, southeastern New Hampshire, and Maine.

74. Crossed southwestern Maine, moving southeasterly.

75. Moved southeasterly over northern Vermont, New Hampshire, and southwestern Maine.

76. Crossed southern Vermont and New Hampshire, moving eastward, then turned northeastward at the coast and crossed Maine.

77. Crossed northern Vermont, New Hampshire, and central Maine.

78. Crossed central Vermont and northern New Hampshire, then turned southeastward and passed over southwestern Maine.

79. The southern of two cyclones into which a cyclone divided at Lake Ontario. It had travelled southeasterly to the Jersey coast from which it crossed southeastern Massachusetts, moving northeasterly.

80. Moved eastward along the southern coast of New England.

81. Moved eastward just north of Vermont and New Hampshire and across northern Maine.

82. Moved eastward across southern Vermont and New Hampshire.

83. Moved eastward north of Vermont and New Hampshire, and across central Maine.

84. Crossed northern Vermont and New Hampshire and southeastern Maine, moving southeasterly.

85. Moved southeastward across southern Connecticut.

86. Moved eastward along the northern boundary of Vermont and New Hampshire and across Maine.

87. Crossed northwestern Vermont moving northeastward.

88. Crossed southern Vermont and New Hampshire and southwestern Maine.

89. Moved near the northern boundary of Vermont and New Hampshire and across northern Maine.

90. Crossed northeastern Maine, moving southwestward.

91. Moved northeastward centrally over Vermont, New Hampshire, and Maine. This cyclone was remarkable for the exceptional depth of the depression, the barometer recording 28.7 inches as the centre passed New England.

92. Crossed northwestern Vermont, moving northeastward.

93. Moved eastward across southern Massachusetts.

94. Moved eastward, north of Vermont and New Hampshire, and across northern Maine.

95. Crossed Massachusetts, moving eastward.

96. Crossed northern Connecticut and Rhode Island, moving easterly. Maximum areas of precipitation were situated on the path, and both north and south.

97. Crossed southwestern Maine from Canada, moving southeasterly.

98. Moved northeastward, crossing centrally Vermont, New Hampshire, and Maine.

99. Passed eastward across the extreme northern parts of Vermont and New Hampshire, and across Maine.

100. Moved southeastward across southwestern Massachusetts and northern Rhode Island, and curved northeastward, passing south of the Maine coast. Maximum precipitation-areas were noted both north and south of the path.

101. Moved northeastward across extreme southern Vermont, southern New Hampshire, and southwestern Maine.

102. Crossed extreme southern Vermont and New Hampshire, and northeastern Massachusetts, moving southeasterly. Two maximum areas were noted, one twenty, the other eighty, miles south of the storm path.

103. Crossed southern Vermont and New Hampshire, moving southeasterly.

104. Moved northeastward, north of Vermont and New Hampshire, into northern Maine.

105. Crossed northern Massachusetts, moving eastward.

106. Crossed southwestern Connecticut, moving southeasterly.

107. Moved eastward, near northern boundary of Vermont and New Hampshire, and northeasterly across northern Maine.

108. Crossed central Maine, moving southeastward.

109. Moved southeastward across extreme northern New Hampshire and southwestern Maine.

110. Crossed northern Vermont and New Hampshire, and southwestern Maine, moving eastward.

TABLE XIV.

CYCLONES WHICH MOVED FROM THE WEST NEAR NEW ENGLAND.

No.	Date of Passage.	Pressure at Centre. (Inches.)	Hourly Velocity. (Miles.)	PRECIPITATION.			
					MAXIMUM AREA.		
				Kind.	Amount. (Inches.)	Distance from Path. (Miles.)	Direction from Path.
111	Sept. 19, 1886	29.6d	35	Rain.	1.0	–	–
112	Sept. 28, "	29.8d	25	Rain.	2.0	150	SE.
113	Oct. 15, "	29.4i	15	Rain.	0.5	360	SE.
114	Nov. 24, "	29.1i	45	Rain.	1.2	460	SE.
115	Nov. 29, "	29.5d	45	Rain.	1.0	300	SSE.
116	Dec. 13, "	29.2d	35	Rain and Snow.	0.6	200	SSE.
117	Dec. 24, "	29.2d	50	Rain and Snow.	1.3	300	SE.
118	Jan. 17, 1887	29.2d	40	Rain and Snow.	1.5	320	SE.
119	Jan. 30, "	29.4d	40	Rain	1.5	375	SSE.
120	Feb. 8, "	29.3d	50	Rain and Snow.	1.8	150	S.
121	Feb. 19, "	29.4i	50	Rain.	2.6	440	S.
122	June 23, "	29.6	–	Rain.	5.0	–	–
123	July 23, "	29.7i	25	Rain.	7.5	425	SE.
124	Aug. 23, "	29.8	15	Rain.	4.7	40	N.
125	Sept. 7, "	29.3i	20	Rain.	2.0	300	SSE.
126	Dec. 11, "	29.8d	45	Rain.	2.5	100	NE.
127	Jan. 7, 1888	29.6d	60	Rain and Snow.	0.4	200	SE.
128	Feb. 8, "	29.5d	25	Rain and Snow.	0.5	240	SE.
129	Feb. 21, "	29.6i	25	Rain and Snow.	2.5	360	S.
130	Feb. 26, "	29.5i	50	Rain and Snow.	1.8	360	S.
131	March 28, "	29.7d	30	Rain and Snow.	2.4	300	SE.
132	May 5, "	29.9i	40	Rain.	0.5	–	–
133	May 12, "	29.6	30	Rain.	3.0	600	SE.
134	May 14, "	29.8	15	Rain.	2.0	240	NW.
135	May 19, "	29.8	20	Rain.	1.0	300	SE.
136	May 29, "	29.7i	25	Rain.	1.2	380	SE.

TABLE XIV. *(Continued.)*

1	2	3	4	5	6	7	8
137	June 6, 1888	29.8	15	Rain.	1.0	200	S.
138	July 19, "	29.9	20	Rain.	1.5	425	SE.
139	July 31, "	29.7	40	Rain.	0.8	400	S.
140	Aug. 26, "	29.7	25	Rain.	1.0	220	SSE.
141	Oct. 20, "	29.6i	20	Rain.	0.8	400	S.
142	Oct. 28, "	29.5d	20	Rain.	2.1	120	S.
143	Nov. 10, "	29.4d	45	Rain.	3.5	540	SSE.
144	Dec. 27, "	29.3d	30	Rain and Snow.	1.2	320	SE.
145	Jan. 10, 1889	29.0i	40	Rain.	1.2	370	SE.
146	Jan. 17, "	29.2	50	Rain.	1.8	500	SE.
147	Feb. 12, "	29.5	20	Snow.	0.6	320	SE.
148	Feb. 17, "	29.6d	45	Rain.	1.8	550	S.
149	May 14, "	29.7	35	Rain.	0.6	250	SE.
150	May 21, "	29.6	20	Rain.	4.0	140	S.
151	May 28, "	29.6	40	Rain.	2.0	390	SE.
152	June 15, "	29.9d	25	Rain.	2.1	480	S.
153	July 4, "	29.7	20	Rain.	2.0	420	SSE.
154	July 23, "	29.6d	25	Rain.	1.0	420	S.
155	Aug. 9, "	29.8	25	Rain.	1.0	550	SE.
156	Oct. 1, "	29.4	20	Rain.	2.0	480	S.
157	Nov. 10, "	29.9	15	Rain.	3.0	–	–
158	Nov. 13, "	29.6d	45	Rain.	1.2	–	–
159	Dec. 6, "	29.9	30	Rain and Snow.	0.6	220	SE.
160	Dec. 9, "	29.8i	55	Rain.	1.5	370	SSE.
161	Dec. 14, "	30.0	60	Snow.	1.0	270	N.
162	Dec. 29, "	29.3	50	Rain and Snow.	0.6	250	SE.
163	Jan. 6, 1890	29.5d	55	Rain.	0.5	100	SSE.
164	Jan. 31, "	29.6	45	Rain.	1.4	560	SE.
165	Feb. 8, "	29.6d	50	Rain and Snow.	2.0	400	SSE.
166	Feb. 14, "	29.2d	45	Rain and Snow.	0.8	350	SE.
167	March 26, "	29.5	50	Rain and Snow.	0.7	320	S.
168	June 7, "	29.7	25	Rain.	2.0	320	SE.
169	July 26, "	29.8	40	Rain.	4.5	280	SE.
170	Sept. 26, "	29.9d	25	Rain.	2.0	–	–
171	Oct. 10, "	29.8d	30	Rain.	0.5	260	SW.
172	Feb. 18, 1891	29.3	60	Rain.	1.5	370	SE.
173	Feb. 21, "	29.5	45	Rain and Snow.	1.0	680	SE.
174	March 13, "	29.3i	35	Rain and Snow.	2.0	480	SE.
175	April 12, "	29.9	25	Rain.	1.3	400	S.
176	April 18, "	29.7d	60	Rain.	1.0	560	SE.
177	July 15, "	29.7	40	Rain.	2.0	320	SE.
178	July 19, "	29.7i	25	Rain.	2.6	300	SE.
179	July 24, "	29.8	35	Rain.	1.7	280	SE.
180	Aug. 21, "	29.5	40	Rain.	2.0	300	SSE.
181	Sept. 29, "	29.7d	40	Rain.	1.0	400	SE.
182	Nov. 12, "	29.8	25	Rain.	1.2	400	SE.
183	Nov. 17, "	29.5	35	Rain and Snow.	1.2	320	SSE.
184	Nov. 24, "	29.1i	30	Rain.	1.0	220	SE.
185	Dec. 5, "	29.5	50	Rain.	1.0	450	SE.
186	March 23, 1892	29.8i	35	Rain and Snow.	1.0	220	S.
187	April 22, "	29.7d	25	Rain.	1.0	560	SE.
188	April 28, "	29.6i	25	Rain.	0.7	420	SSE.
189	May 16, "	29.7d	30	Rain.	1.0	480	SSE.
190	June 10, "	29.8d	25	Rain.	1.0	110	NE.
191	July 15, "	29.5d	40	Rain.	1.2	440	SE.
192	Aug. 31, "	29.7	30	Rain.	0.6	400	SSE.
193	Sept. 15, "	29.7	20	Rain.	3.2	320	SE.
194	Oct. 16, "	29.8	30	Rain.	1.0	520	SSE.

NOTES.

In the preceding table the paths of the cyclones may be grouped as follows: —

Nos. 111, 112, 117, 118, 125, 127, 130, 131, 135, 149, 150, 162, 166, 169, 178, came from the lakes and passed down the St. Lawrence valley, north of New England.

Nos. 113, 115, 116, 119, 121, 123, 129, 133, 136, 143, 144, 145, 147, 148, 151, 153, 155, 164, 165, 168, 172, 173, 174, 177, 180, 184, 187, 189, 191, 192, moved from the Lakes, or north of them, northeasterly far north of New England.

Nos. 114, 120, 128, 137, 138, 139, 140, 141, 142, 146, 152, 154, 156, 159, 160, 163, 167, 171, 175, 176, 179, 181, 182, 183, 185, 186, 188, 193, 194, moved easterly in Canada, north of New England, in some instances crossing the extreme northern part of Maine where no stations are located, but usually farther north.

Nos. 124, 126, 134, 157, 158, 161, 170, 190, came from the west or northwest, and entered the ocean south of New England. In these eight cases, therefore, the region covered by the observing stations lies north of the path of the storm.

The following facts are interesting in this study: —

111. The maximum area of rainfall was at the northern boundary of New England, and Canadian reports show that the rainfall was heavier north of New England, and near the storm track.

122. This depression was in Canada, too far north to be traced. The rain was very heavy in New England, and came in a series of thunderstorms. The maximum area, from five to six inches, extended from southwestern Connecticut to central New Hampshire.

123. While this cyclone was moving northeasterly in Canada, an extensive series of showers prevailed in New England. The maximum rainfall, exceeding seven inches, was in western Massachusetts.

132. The centre of the depression was too far north to be located. The rainfall was light, the maximum falling along the southern coast.

157. This depression came overland to the Virginia coast, thence easterly south of New England. The heaviest precipitation was on Long Island, and seemed to be increasing towards the storm track.

158. This depression having entered the ocean from Virginia, passed south of New England, and curved northeasterly along the Maine coast. The maximum rainfall was on the coast, increasing towards the storm track.

170. This depression moved from the Lakes southeasterly to Long Island Sound, thence easterly south of the coast, where the heaviest rainfall was noted, increasing towards the storm track.

The data of the preceding tables were gathered for the purpose of studying the distribution of the precipitation. Incidentally, however, they indicate the following facts: —

1. The velocity with which the storms passed New England ranged

from 15 to 60 miles per hour, and is about the same whether the centre passed over New England or north or south of it.

2. Of the 69 storms whose tracks lay over New England, 16 or 23 per cent were diminishing in energy, as shown by the gradual rise of the barometer; 36 or 52 per cent were increasing in energy, as indicated by the fall of the barometer while the centre was passing. The others, or 25 per cent, showed little change in the depth of the central depression. If we combine with these figures those of the earlier investigation, we find that of 83 storms in all, 44, or 53 per cent were increasing in energy, and 17, or 20 per cent, diminishing in energy, while 22, or 27 per cent, showed no change in energy while in transit.

3. Similarly for the 84 storms whose paths lay beyond New England's boundary, 76 north and 8 south, 17, or 20 per cent, were diminishing in energy, 30, or 36 per cent, were increasing in energy, and in the case of the remaining 37 increase or decrease in energy was not determinable. Including the storms of the earlier study we have in all 92 storms, of which 31, or 34 per cent, were increasing in energy, 20, or 22 per cent, diminishing, and of 41 increase or decrease could not be determined. But in this class of storms, failure to determine whether the pressure was rising or falling at the centre is largely due to the lack of data when the centre was beyond the region of reports, and does not indicate that the pressure was actually stationary. The percentages are, therefore, not as reliable as in the former case.

Coming now to the distribution of the precipitation, the following facts are indicated:—

4. The maximum precipitation ranges in amount from a quantity just measurable in a gauge to 4.5 inches for storms whose centres passed over New England, and to 7.5 inches for those whose centres were beyond the boundary. Amounts exceeding 2 inches are, however, unusual, as is shown by the sixth column of the tables, and the average is 1.6 inches for the former and 1.7 inches for the latter class.

5. The seventh and eighth columns of the tables show very plainly how rarely the heaviest rainfall or snowfall is found along the central path of the storm. Thus in the case of storms whose centres crossed New England, Table XIII., out of 69, only 10 have their heaviest precipitation on or near the storm path; 45 have the maximum area on the right of the storm track, facing the direction in which it is moving, and 14 on the left of the track. As the general direction of the storm movement is eastward, these appear as S. and N. respectively in the table. New England does not extend over a sufficient area in latitude to show where the maximum areas lie on both sides of the track, unless the track crosses the territory nearly centrally. Usually the area on either the southern or the northern sides is well marked, but the other, if it exists, is beyond the region of observation. The preponderance of southern maxima is due in part to the preponderance of storm tracks in the northern part of New England, and does not necessarily indicate that the heaviest precipitation is usually south or on the right of the track. In some cases, notably

Nos. 96 and 100, two maximum areas were noted, one on either side of the path.

6. Similarly for the second group of storms, Table XIV., out of 84 cases, 73 have their maximum precipitation south of the storm track, five north of it, and in six cases the relation of the maximum area to the storm path is undetermined. These six storms cover all instances in which the amount of precipitation increased progressively towards the storm path, with the maximum noted on the boundary of New England. The natural inference would be that the increase might continue to the storm track itself; at least this is undetermined. But in the 73 storms there was a falling off in amount between the maximum area and the position of the storm centre, so that we are justified in locating a maximum area at the measured distance from the storm track, the latter beyond the boundary of the region of observation. It is evidently possible that this may be a secondary maximum, and that another maximum may exist along the storm path itself. The storms in which the maximum is north of the path are five of the eight cases of storms whose centres passed south of New England. The other three had their heaviest precipitation along the southern coast, and heavier precipitation may have occurred still nearer or at the storm path. The six undetermined cases contain these three and three others similarly situated on the northern boundary.

7. The data of column 7 show that in the case of storms whose centres pass over New England, the distance from the centre of the maximum area may reach 320 miles for an area south of the centre, and 180 for one north of the centre. The average is 135 miles for the 45 storms having their maxima south of the path, and 91 miles for the 14 storms whose maxima were north of the path. Including the storms of the preliminary discussion, the averages are: 129 miles, 52 storms with maximum areas south of the path; and 103 miles, 18 storms with maximum areas north of path.

8. Similarly for the second group of storms, the average distance is 360 miles for the 73 cases in which the maximum area is south of the path, and 152 miles for the 5 cases in which it lies north of the storm track. Including the storms of the preliminary discussion, the former group contains 78 cases whose maximum areas are south of the path, and the average distance is 357 miles.

Comments on the significance of these facts are reserved until the results of a similar study of the storms which visit New England from the south are given.

CLASS II.

STORMS PASSING OVER OR NEAR NEW ENGLAND FROM THE SOUTH.

The following tables are prepared on the same plan as those of Class I. : —

TABLE XV.

CYCLONES WHICH MOVED FROM THE SOUTH ACROSS NEW ENGLAND.

No.	Date of Passage.	Pressure at Centre. (Inches.)	Hourly Velocity. (Miles.)	PRECIPITATION.			
				Kind.	Maximum Area.		
					Amount. (Inches.)	Distance from Path. (Miles.)	Direction from Path.
195	Nov. 13, 1886	29.4d	25	Rain and Snow.	2.0	90	NW.
196	Nov. 25, "	29.4d	50	Snow.	1.8	120	NW.
197	Dec. 16, "	29.5d	40	Snow.	0.9	80	NW.
198	Jan. 1, 1887	29.5d	25	Rain and Snow.	1.6	40	SE.
199	March 22, "	28.9d	30	Rain and Snow.	1.8	50	NW.
200	April 26, "	29.5d	40	Rain and Snow.	1.1	90	NW.
201	Nov. 15, "	29.3d	30	Rain and Snow.	2.0	50	NW.
202	Dec. 18, "	28.9i	20	Rain and Snow.	1.2	120	NW.
203	June 1, 1888	29.6	35	Rain.	0.9	90	NW.
204	Aug. 21, "	29.5	40	Rain.	5.0	20	NNW.
205	Sept. 26, "	29.2	25	Rain.	4.8	40	WNW.
206	Oct. 24, "	29.6	30	Rain.	2.0	140	N.
207	Nov. 15, "	29.6d	40	Rain.	1.8	40	NW.
208	Nov. 27, "	29.5i	10	Rain and Snow.	6.1	20	NNW.
209	Dec. 18, "	28.8	40	Snow.	4.6	30	NW.
210	March 7, 1889	28.8i	10	Rain and Snow.	2.5	0	–
211	March 6, 1890	29.9	40	Snow.	1.0	120	NW.
212	May 27, "	29.7	15	Rain.	4.5	60	NNW.
213	March 4, 1891	29.6d	15	Rain and Snow.	2.0	50	NW.
214	March 9, "	29.7i	50	Rain and Snow.	2.2	40	ESE.
215	April 3, "	29.4d	15	Rain.	3.0	100	NW.
216	May 16, "	29.6i	25	Rain.	1.8	0	–
217	Oct. 8, "	29.7d	50	Rain.	3.0	0	–
218	Jan. 6, 1892	29.3d	50	Rain and Snow.	1.0	0	–
219	March 18, "	29.1d	25	Rain and Snow.	2.0	0	–

NOTES.

The following notes state concisely the path of each cyclone over New England, with other facts bearing upon the discussion : —

195. Moved from Texas northeasterly, entered the ocean south of Long Island, and crossed Cape Cod.

196. The path was quite similar to the preceding.

197. Moved southeasterly from Michigan to the Virginia coast, thence northeasterly across Long Island and southeastern Massachusetts.

198. Originated in Long Island Sound, and crossed Connecticut, Rhode Island, Massachusetts, Massachusetts Bay, into Maine, and thence to Nova Scotia.

199. Entered the ocean from South Carolina, moving northeasterly, crossed eastern Long Island and Cape Cod.

200. Passed from the Gulf of Mexico to the Virginia coast, and thence just outside of Cape Cod.

201. Moved from the ocean, south of Long Island, northeasterly across Cape Cod to the Maine coast, and thence easterly.

202. Came from the Gulf to the Virginia coast and crossed southeastern Massachusetts to the Bay and the Maine coast.

203. Originated south of Long Island, and crossed eastern Connecticut, Massachusetts, New Hampshire, and Maine.

204. A tropical hurricane which curved to the northeast as it entered Louisiana from the Gulf, and crossed Rhode Island and southeastern Massachusetts, with very heavy rainfall.

205. Moved from the Bahamas northward in the ocean, crossing southeastern Massachusetts, with very heavy rainfall.

206. Came from Louisiana, northeasterly over the land to southeastern New York, thence easterly in Long Island Sound.

207. Moved from the Gulf northeasterly to the Delaware coast, thence across southeastern Massachusetts and along the coast of Maine.

208. A southern storm which had moved westerly in the ocean north of the West Indies, thence northerly in the Atlantic to Cape Cod and the Maine coast. The precipitation was excessive rain and snow.

209. Came from the northwest to Maryland, and then curved to the northeast and crossed Connecticut, Rhode Island, and southeastern Massachusetts to the ocean. The depression was below 29 inches, and the snow excessive.

210. Crossed Nantucket moving northeasterly, and curved to the northwestward on reaching the Maine coast. The pressure was below 29 inches. There were several areas of maximum precipitation, along the path and at various distances from it.

211. Moved from the Virginia coast northeasterly across Cape Cod.

212. Formed in Chesapeake Bay and crossed Cape Cod.

213. Crossed Cape Cod, moving northeasterly from the South Carolina coast.

214. Moved northeasterly from the Gulf within the coast line, came up the Hudson valley, and crossed the extreme northwestern part of Vermont.

215. The path was like that of No. 211.

216. Moved from off the New Jersey coast, first southwesterly, and then returned and moved eastward across southeastern Massachusetts.

217. Moved from Virginia northeastward across Rhode Island and southeastern Massachusetts.

218. Moved from the coast off North Carolina, northeastward across Connecticut, Massachusetts, southeastern New Hampshire, and western Maine.

219. Moved from the South Carolina coast northeastward, crossed Cape Cod, and continued northward across western Maine.

(*To be continued.*)

THE BAROMETER AT SEA.*

T. S. O'LEARY.

EVER since Torricelli, that brilliant pupil of Galileo, made his famous experiments in 1643, the barometer has been both a familiar and valuable instrument to all civilized nations. It is now absolutely necessary in conducting all scientific experiments where the pressure of the atmosphere is a factor. But so much has been written on its construction, care, uses, and reliability, it would be a waste of time to attempt to cover ground that has already been so carefully gone over. As the subject is a large one, it is much beyond the scope of this paper to treat it, though briefly, in all its phases in the time allowed. I shall confine myself, therefore, to a few general remarks.

Although the U. S. Hydrographic Office has been collecting ocean data ever since the time of Maury, it has been within the past few years that special efforts have been made to systematize the collection of these data and use of the same. A great step forward was made when the meteorological log journal, which required observations to be made at twelve different times during every twenty-four hours, was superseded by the meteorological log book, which requires but one regular observation to be made daily. The hour fixed is noon, Greenwich mean time, so that no matter in what part of the ocean the observations are being made the observers are acting simultaneously. This simplified log was found to be much more desirable than the journal, as observers were induced to continue the work, who, after filling one journal, were apt to decline keeping another on account of the labor involved. The result has been that the number of observers has increased nearly eightfold, so that the oceans are now dotted with many interested workers.

Another valuable feature is the indenture of the leaves of the new log book, which enables the observers to remove the pages as fast as they are filled up and forward them to the Hydrographic Office, there to be utilized in current work. The master of a vessel, or the observer, wants to see the results of his

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observations while the facts are still fresh in his memory and while he is yet interested in what has recently taken place. The pilot chart of the North Atlantic attempts to satisfy this want by placing before the mariner in a graphic form such matters as are deemed of interest or importance to him. For his time and trouble the observer wants a ready return if possible. The accumulation of several years' data in the home meteorological offices, there to be compiled at leisure, then to appear in a volume too bulky for reading and too scientific for the ordinary navigator, with too much attention paid to minor details, is a danger which should be carefully guarded against.

The past has shown that the above cause has driven from the field many good observers who were once interested, and kept out of the field many more whose co-operation would have been of the greatest value. The loss of their services is a direct loss to the science of marine meteorology, but, let us hope, it is not too late to again stimulate them to further efforts.

It goes without saying that mercurial barometers are the best and most reliable, but, unfortunately, a good mercurial instrument is an expensive one. For this reason many sea-going vessels are supplied with aneroids only. Some are supplied with both, but generally the mercurial, the reliable one, is placed in the captain's cabin, where he alone has access to it. On other vessels it is often placed too high, where the light is not good, or more with regard to its safety than its accessibility, so that on a dark night, during heavy weather, the observer experiences no little difficulty in getting even an approximate reading. Generally speaking, the placing of many barometers, especially in merchant ships, is in the interest of the vessel and its owners and not in the interest of science. We must accept the situation as we find it, and deduce from the data furnished the best results we can.

First of all, the most important thing in considering a set of barometers reading is to determine the reliability of the instrument and observer. To do this, frequent comparisons with a standard barometer are necessary of readings recorded *by the observer himself.*

A simple plan for obtaining these comparisons has been in use by the United States hydrographic offices for the past three years, and the results obtained have been most satisfactory.

The credit of the plan is due to the force employed in the Meterorological Division of the Hydrographic Office at Washington, which plan was arrived at after the mistakes and difficulties of former methods in use had been clearly demonstrated. I cannot do better than give an account of the plan now in use. Although simple in the extreme, it answers all practical purposes.

On the arrival of a vessel in port the meteorological reports are forwarded immediately to the nearest branch hydrographic office. Accompanying the acknowledgment of the receipt of these reports are two or more franked postal barometer cards, on the back of which are brief instructions showing how the columns should be filled. When in ports of the United States or Canada, observers are requested to record the readings of the barometer used for observations at sea at 8 A. M. or 8 P. M., seventy-fifth meridian time, as at those hours the United States Weather Bureau observers record their observations. If the vessels are in those ports where branch hydrographic offices are located, readings at other times will answer, as a record is kept of the hourly readings of the standard in each office. When the cards have been properly filled out they are mailed by the observer to the branch hydrographic office, where each reading is compared with that of the standard instrument for the corresponding time. A copy of these comparisons is immediately furnished the observer. The original cards are forwarded to the Hydrographic Office at Washington, where the comparisons are examined and copied, after which they are returned to the branch offices whence they came, there to be filed away, so that any master or observer can readily find out how his barometer has been acting from month to month or from year to year. In making these comparisons it has been found best to take the absolute difference between the reading of an aneroid and the corrected reading of the standard as the total correction to be applied to all the readings of the aneroid for that pressure. With mercurial barometers the reading is first corrected for temperature; the difference, then, between that result and the corrected reading of the standard is the correction to be applied to the reading of the mercurial. It is evident that these total corrections are but the algebraic sum of the instrumental error, correction for altitude, and personal error of the observer.

This last error is of no little consequence, for if the observer is not faithful in recording the observations at the proper time, his work is no more reliable than that of a faithful observer with an inferior instrument.

It might be contended that the corrections obtained from comparisons made in port when the vessel is light would not answer when she was at sea deep laden. Supposing this difference in heights of the barometer to be fifteen or twenty feet the difference of correction would be only one or two hundredths, an unnecessary refinement when it is remembered that in the height of the storm, or when the mercury is "pumping" considerably, an approximate reading is all that can be obtained.

Another method of obtaining comparisons, which has proved quite satisfactory, is by making use of the isobars on the United States Weather Maps and the readings at the stations along the coast. As the morning readings are taken at 8 o'clock, seventy-fifth meridian time (or 1 P. M., Greenwich mean time), there is only an hour's difference between the shore readings and the readings at sea. Under normal conditions this is not of much consequence, especially when the pressure changes only a few hundredths in as many hours. Use is made, also, of the 2 P. M. readings of the British Daily Weather Report. It will be seen that "checks" obtained from the readings of a vessel's barometer while in the vicinity of Key West, Jupiter, Hatteras, Block Island, or Nantucket on this side, and again near the outer stations, such as Moville, Valentia, Bishop's Rock, or Dungeness on the other, would determine pretty well whether or not the readings for the voyage should be rejected.

These comparisons are often the only ones attainable, as the many duties of the officers while in port leave them little or no time for filling out blanks. Hence, the importance of these shore readings when vessels are adjacent to the stations. It might be mentioned in this connection that the readings recorded on the vessels at the time are obtained under the same conditions, most likely, as those recorded for the previous or subsequent part of the voyage, which fact lends value to the comparisons.

This second method of obtaining comparisons is confined at present to vessels approaching or leaving the east coast of the United States or the coasts of Europe. It is to be hoped, how-

ever, that in the near future reliable readings from standard instruments for noon, Greenwich time, will be promptly furnished from the Azores, Canaries, Cape Verde, and West Indies, so that corrections for vessels' barometers can be obtained in much the same manner that a navigator determines his chronometer error when in the vicinity of a place, the latitude and longitude of which have been accurately determined. Without a good idea of the approximate correction to be applied to the readings furnished, the investigator will find it quite difficult to harmonize ocean barometric data.

It is to be regretted that the morning observations for the United States Weather Service are not made an hour earlier, and the 2 P. M. observations of the British Weather Service two hours earlier. If such were the case, the observers, both on land and at sea, would be working in conjunction with each other, and the simultaneous observations would extend over Europe, the United States, and all the oceans. In the northern hemisphere particularly could the meteorological conditions be studied to better advantage, with observations taken at the same time over an area extending from Russia on the east to the east coast of Asia on the west, or over two hundred and fifty degrees of longitude. The importance of the change suggested and the benefit resulting therefrom are worthy of serious consideration.

The records of the Hydrographic Office for the past three years show that on 5,425 voyages or parts of voyages made by 1,600 vessels the readings of the mercurial barometers were deemed reliable in 4,321 cases, while in the remaining 1,104 cases they were discarded or considered doubtful. With the aneroids, out of a total of 8,898 voyages or parts of voyages, in 4,160 cases the readings were considered reliable, and in 4,738 cases unreliable. In other words, 80 per cent of the mercurial readings could be fairly depended upon and only 46 per cent of the aneroids. These represent about 250,000 barometer readings for the North Atlantic, of which about 130,000 were plotted and 120,000 discarded. The large per cent of unreliable readings can be attributed to many causes, some of which are inferior instruments, carelessness in reading, wrong time for observing, and wrong position given for time of observation. Many of these mistakes have been corrected as

the observers have grown more familiar with the work. This is evidenced by the decided improvement to be noticed in the consistency of the readings plotted in the successive volumes of the daily synoptic maps of the North Atlantic. It is fair to presume that in a short time 80 or 85 per cent of all the barometric readings received will be plotted instead of 63 per cent, as previously shown.

The large difference in per cent between the reliable mercurial barometers and reliable aneroids will not escape notice, and while the superiority of the former instruments is undoubtedly established I would hesitate long before casting aside the readings of all aneroids simply because they were aneroids. In many instances, especially in those parts of the ocean the least frequented, readings from aneroids are the only ones obtainable. With a fair correction these readings assist to establish the origin of a "low," perhaps, or prolong a storm track beyond the well-defined paths of commerce. Although mercurial readings are to be preferred, the prejudice against aneroids should not be too strong. While some are bad all the time, not all are bad all the time. The lowest reading plotted on any of the daily synoptic maps is that of an aneroid, which was considered tolerably reliable. At 10 A. M., Greenwich mean time, Feb. 1, 1892, the British steamship "Bellini," in N. 59° 38′, W. 7° 02′, had a barometer (aneroid) reading of 27.47 inches. Applying the correction, +0.15, for this instrument, the corrected reading would be 27.62 inches. As the reading recorded by the observer of the British Weather Service at Sumburgh Head at 6 P. M. of that day was 28.02 inches, with steep gradients to the westward, and as the storm centre passed to the northwest of the Shetland Islands, it is not unlikely that the corrected reading of the "Bellini's" barometer, 180 miles west of Sumburgh, and near the storm centre, was not far from a correct pressure. The correction applied in this instance, +0.15, was obtained from comparisons on this, the preceding, and the subsequent voyage.

The next lowest reading plotted is that of the Dutch steamship "Werkendam" in the cyclone of Dec. 22–23, 1892. At 2 A. M., Greenwich mean time, Dec. 23, in N. 49° 41′, W. 30° 41′, the corrected reading of this instrument (mercurial) was 704 mm., or 27.72 inches.

The highest reading so far plotted is 790 mm., or 31.10 inches,

the corrected reading of the German steamship "Fulda's" mercurial barometer, at noon, Greenwich mean time, Jan. 14, 1891, in N. 49° 57′, W. 14° 50′. These readings would indicate that at sea the greatest range of the barometric column occurs in the high latitudes during the winter months, the same as on land, and is about 84 mm., or 3.5 inches.

The importance of frequent comparisons cannot be overestimated. To illustrate, the mercurial barometer of a well-known trans-Atlantic liner, after being quite regular for two years, suddenly changed so that a correction of +0.78 of an inch was necessary. The observer being notified of the fact began using an aneroid. The latter instument was found to be 0.50 of an inch too high. Here, then, were two barometers on the same vessel with a difference of 1.38 inch in their readings. This is, perhaps, an exceptional case, but it shows that each and every barometer should be carefully "checked" before the readings are plotted as final. Out of the 1,600 vessels previously mentioned the author has taken 70 that had good barometer records. The records show that of these barometers 60 were mercurial and 10 aneroid, and that the average variation of the 70 barometers over a period of twenty-five months was only 0.04 of an inch. Only those records were taken where the variation in the correction applied was less than 0.10 of an inch, and where the barometer had been in use more than a year. The superiority of the mercurial barometers is here again shown by a ratio of 6 to 1. Of the 60 mercurial barometers it was necessary to apply a plus correction with 50 and a minus correction with the remaining 10, which fact might indicate that even with the good observers the tendency is in reading mercurial barometers to move the vernier too far down and thus read too low.

An intelligent interpretation of the prevailing conditions as indicated by the barometer, direction and force of wind, state of sea, and atmosphere, with a view to not only the present but the future action of his vessel, should be the object of every mariner. At the approach of a cyclone, or even when the storm is on, the action of the barometer together with the shifts of wind will determine the all-important point of which tack to lay the vessel on. This done, and the storm passed, the next thing is to take advantage of the future shifts by so laying the course,

when first able to proceed, that the different shifts will be provided for beforehand and the vessel allowed to continue on her way without the probability of being headed off. Good judgment in this direction, based upon the knowledge we already have of the general laws of atmospheric movements, will often serve to shorten the passage and bring the vessel into port without much working. It is not only in bad weather, but in good weather also that the master should be on the alert. The approach of a "high," with successive shifts of wind due to that circulation, should be as well understood and manœuvred for as the approach and shifts of a "low," and for the same reasons as given above. This important subject is worthy of the fullest investigation and should be thoroughly mastered by every navigator.

In conclusion, I would beg to submit for your consideration the following suggestions : —

That the members of this Congress impress upon their respective governments the desirability and importance of at least one set of simultaneous observations taken daily ; that the hour be noon, Greenwich time, for reasons previously mentioned ; that all barometer readings be "checked" by frequent comparisons before being used ; that a uniform and simple system of recording observations by mariners be adopted ; that the recording of observations be encouraged among shipmasters and officers, and also the study of ocean meteorology by putting before them from time to time, and in as graphic a manner as possible, the explanation of the general laws of atmospheric movements and such other matters as would be beneficial to them ; and finally, that all the data collected be used in an exhaustive manner to the end that from a thorough investigation of the results obtained our knowledge of the subject of ocean meteorology may be considerably increased.

CURRENT NOTES.

Systematic Explorations of the Upper Air. — In the September number of *Aëronautics*, Prof. Mark W. Harrington, Chief of the Weather Bureau, has a paper on "Systematic Explorations of the Upper Air, with Estimates of Cost," of which the following is a summary: —

In the exploration of the upper air lies the great hope of the satisfactory advance of meteorology. The observations taken on mountain stations, though extremely valuable, do not meet the requirements of the meteorologist, for mountain stations are really only stations on the earth's surface, and cannot give definite results regarding what goes on at considerable elevations in the free air. The use of the spectroscope promises much in the direction of exploring the upper air by investigating the ray of light which has passed through it. The twinkling of the stars has also been studied in this connection, and Señor Ventosa has shown that the fluctuations on the margins of the larger celestial bodies, when viewed through the telescope, have apparent relations with the upper winds.

Systematic explorations of the free air must be made by means of elevated towers, kites, pilot balloons (without aëronauts), and balloons carrying aëronauts. The Eiffel Tower, in Paris, has been the means of giving us a very valuable series of observations from the stratum of air below 1,000 feet in height, but such towers are very expensive to build, and do not reach high enough for the study of the upper air.

The method of exploring the free air by means of kites has been carefully studied by Mr. William A. Eddy, of Bergen Point, N. J. Mr. Eddy uses tailless kites, placed in tandem, and flown in groups of three. By this means he has reached heights of 5,000 feet, and expects to reach 14,000 feet without serious difficulty. In regard to the cost of carrying meteorological instruments to this height, Mr. Eddy has estimated it at about $170, this sum including the price of thirty-three kites, 23,000 feet of twine and rope, windlass, and the wages of four laborers. The kites are flown in groups of three, as just stated, and the instruments are suspended between two groups of three kites each. As a result of Mr. Eddy's calculations, it appears that the current expenses for such an investigation for a year would be $5,840, and adding the cost of instruments ($2,500) and outfit and incidentals ($1,660), a total of $10,000 is reached, which would pay for a year's systematic work of this sort, not including the salary of the officer in charge.

Pilot balloons have been used for half a century or more in occasional studies of the lower air currents, but no systematic use has been made of them until very recently. A rich field of investigation is open along this line. By carefully studying the weather map from day to day, and securing

the services of persons capable of using the theodolite, an observer, by sending up a series of pilot balloons at frequent intervals during the passage of a "low" or "high," could secure some notable results. The cost of such observations, aside from the salary of the principal observer, would probably not be over $150 a year at any one station, as the number of favorable opportunities at each station would be limited. For $30,000, therefore, these observations could be made at twenty colleges over the States.

M. Hermite, in 1892 and 1893, sent up a number of pilot balloons carrying self-registering instruments, and one such balloon, on March 21, 1893, reached a height of ten miles. A calculation, made by Prof. H. A. Hazen, as to the cost of sending up pilot balloons with self-registering instruments, goes to show that $5,000 would permit of one such balloon per week during the year to the height of four miles, and perhaps one per month to the greater height.

The best exploration of the free air can be made by a meteorologist who makes the ascension in a balloon himself, for, besides the continuous records made by the instruments, careful notes are necessary, in order that correct deductions may be made. In order to accomplish this work thoroughly, a meteorologist should ascend twice a day, perhaps up to 20,000 feet, and should keep this up through all kinds of weather and through the season. The cost for one year's exploration of this sort would be about $20,000.

Prof. Harrington's conclusion is as follows: "It appears that a year's campaign could be made in the free air as follows: —

To 3,000 feet (perhaps) with small balloons	$3,000
" 14,000 feet with kites	10,000
" 20,000 feet, 52 pilot balloons " 50,000 feet, 12 " "	3,000
" 20,000 feet with aëronaut	20,000

"The results to be obtained would be cheap at any of these prices, but the fourth method seems to me incomparably the best, as well as the most certain. A year's campaign of this sort would add very greatly — more than in any other possible way in the same time — to the knowledge of meteorology and hence to the forecasting of the weather. There is no other way, I believe, in which this sum of money could be expended to the greater advantage of meteorology."

The Work of Dust. — Under the title The Work of Dust, there is in the "Popular Science Monthly" for September, a translation of an article by Dr. P. Lenard, originally published in German. Dr. Lenard says: "Dust has a very large share in nearly all the phenomena of the earth's atmosphere. It is what makes the clear sky appear blue; and when we look up into the sky we see the dust in the atmosphere illuminated by the sun. There is nothing else before us that can permit the light to reach the eye. Light goes invisible, straight through all gases, whatever their chemical composition. The dust catches it, reflects it in every direction, and so causes the whole atmosphere to appear clear, in the same way that it makes the sunbeam visible in the darkened room. Without dust there would be no blue

firmament. The sky would be as dark as, or darker than, we see it in the finest moonless nights. The glowing disk of the sun would stand immediately upon this dark background, and the same sharp contrast would prevail upon the illuminated surface of the earth — blinding light where the sun's rays fall, and deep black shadows where they do not. Only the light of the moon and the stars, which would remain visible in the daytime, would be able to temper this contrast in a slight degree. . . .

"But if dust makes the sky appear clear, why is the color of the sky blue? Why does dust, of the different constituents of white sunlight, reflect the blue, rather than the green, yellow, and red? This fact is connected with the size of the dust particles. Only the finest dust settles so slowly that it can be spread everywhere by means of the air currents, and can be found constantly in all strata of the atmosphere; and special importance can be ascribed only to these finest particles. The coarse parts soon fall to the ground. Let us consider the fine mechanism of light, the extremely short ether waves which determine its existence. These waves, although they are of even less than microscopic size, are not all equally long. The shortest are those that give blue light, while all the other colors are produced by longer waves. The fine atmospheric dust contains many particles which are large enough to reflect the short blue ether waves, fewer that can reflect green and yellow, and fewer still large enough to reflect the long red waves. The red light, therefore, goes on almost without hindrance, while the blue is more liable to be diverted, and thus to reach the eye. A similar phenomenon may be observed on a larger scale on water which is roughened with waves of different lengths, and on which pieces of wood are floating. The pieces of wood stand in the same relation to the water waves as the dust particles to the ether waves. The great long waves pass the blocks undisturbed, only rocking up and down; while the finer ripples of the water are turned back as if the blocks were firm walls. . . .

"There is much coarse dust in large towns, when the sky over them is often gray, while only the finest blue dust is carried up in the country. The dust is also variously assorted at different heights above the surface of the earth. The coarser dust will be found at the lower levels, where it is produced. On mountains we have most of the dust beneath us, while the rarefied air can sustain only the finest floating particles. Hence the sky on high mountains is clear and deep blue, even almost black, as if it were without dust. Only when we look at the lower strata, toward the horizon, does the color pass into gray. Why is the sky in Italy and the tropics of a so much deeper blue than that of western Europe? Is the dust there finer? It is really so; not that a finer quality of dust is produced there, but because in the moist climate of the North Sea countries the dust cannot float long in the air without being charged with water and made coarser, while in warmer countries water exists in the air as vapor, and does not become condensed as a liquid on the dust. . . .

"Without dust there would be no condensation of water in the air — no fog, no clouds, no rain, no snow, no showers. The only condensing surface would be the surface of the earth itself. Thus, the trees and plants and the walls of houses would begin to trickle whenever cooling began in the air.

In winter all would be covered with a thick icy crust. All the water which we are accustomed to see falling in rain-pours or in snow would become visible in this way. We should at once feel on going out of doors that our clothes were becoming wet through. Umbrellas would be useless. The air, saturated with vapor, would penetrate the interior of houses, and deposit its water on everything in them. In short, it is hard to conceive how different everything would be, if dust did not offer its immeasurable extent of surface everywhere to the air."

Arctic Temperatures. — Writing of Arctic Temperatures and Exploration in the "Popular Science Monthly" for September, Mr. Stuart Jenkins says: "The extreme cold of the arctic regions is generally looked upon as the principal bar to exploration in that direction, notwithstanding the fact that men have endured its rigors for years without injury. Take some of the cases on record. In 1743 four seamen went ashore on the island of Spitzbergen from a Russian vessel. A heavy storm drove the ship away before they could rejoin her, and they were left with nothing but a gun and enough ammunition to kill twelve deer. That was their entire outfit, yet they managed to live and keep their health for six years, when three of them were rescued, the fourth having died. No properly organized polar expedition would have to submit to the hardships which they must have endured.

"In 1819–20, Parry wintered in Melville Island in latitude 74° 26′. The greatest cold was experienced in February, when the thermometer fell to —55° F., and for fifteen hours was not above 54° F. The expedition was absent eighteen months, and out of two ships' crews only one man died — of a disease in no way referable to the hardships of the voyage. . . .

"It was my privilege to be connected as instrument-man with a survey party which went out to the Canadian Northwest under the command of Mr. G. B. Abrey, D. L. S. (now engineer of Toronto Junction). The party consisted of fourteen men all told, and was out under canvas for twelve months, from June, 1882, to June, 1883. . . . A regular record of temperature was kept during the winter. Our thermometer was a standard spirit one graduated to — 62°F., and had been tested at the Toronto Observatory. The record is on file in the Dominion Crown Lands office. From the first of November the temperature fell in a series of remarkably regular jumps, that is, there would be three days of cold, then a few days of slightly higher temperature, then another three days of cold, and so on, each drop being colder than the last. This went on with unbroken regularity until the third week in January, when it began to rise again in the same way, and with equal steadiness.

"On Christmas day the weather was beautiful, still and cloudless, and the thermometer stood just at zero. . . . I worked all day with the door of the tent wide open, in my shirt-sleeves and bare-handed; and from 9 A. M. to 3 P. M. there was no fire in the stove. I slipped on my coat at noon when I was eating my dinner, but took it off again immediately after. The men spent most of the day lounging about the camp in their shirt-sleeves, smoking and skylarking. . . . The next morning the cook came bustling in with the breakfast, his shirt-sleeves, as usual, rolled up above the elbows. 'The

bottom 's dropped out of the thermometer,' he said, with a laugh. I hurried outside, and, sure enough, the spirit had deserted the tube, and lay inclosed in the bulb — that is, it was lower than —62°F. It was startling, but there was no getting round the fact. . . . The next night the thermometer went down to —58°F., and the third night to —61°F. Now, according to all precedent, we should have spent those three nights cowering with quaking hearts over the stoves, and using the cook's fat to make the fires burn. As a matter of fact, we went to bed as usual and slept without any fires at all. Not only that, but we suffered no discomfort. The only unpleasant thing about it was turning out of one's blankets in the morning to light the fire, and that, I admit, *was* cold, but still nothing that a strong man could not stand with equanimity."

The Congress of the Science of the Atmosphere, at Antwerp. — In spite of the fact that the Meteorological Congress, held at Antwerp on August 16–18, was planned at a late date, and that there were several other scientific meetings going on at about the same time in England, France, Holland, and Sweden, it is a pleasure to note that the Congress was very successful. Many interesting and valuable communications were read, abstracts of which will be published in this JOURNAL as soon as practicable. Among the meteorologists present were Messrs. A. Lancaster, J. Vincent, and C. Hooreman, of Belgium; S. C. Hepites, of Roumania; A. Lawrence Rotch, of Blue Hill Observatory, Readville, Mass.; Stokes, of Margate, and others. Among those who sent in their names as members of the Congress, but were unable to attend, were Prof. Dr. Hellmann, of Berlin; M. Janssen, of Meudon; M. de Rocquigny-Adanson, of Monlins; M. J. R. Plumandon, of the Puy-de-Dôme; M. L. Teisserenc de Bort, of Paris; Mr. R. DeC. Ward, of Cambridge, Mass., and many others.

Weather Bureau Notes. — The result of the recent examination for the position of Forecast Official was as follows: Messrs. Morrill and McAdie were tied for first place; Mr. R. E. Kerkam was second; Mr. E. B. Dunn, third; Mr. B. S. Pague, fourth, and Mr. Clarke, fifth. In the second examination between Morrill and McAdie, Morrill won, and was accordingly appointed Forecast Official. The percentages were higher than those previously made. The other forecast positions were filled by the appointment of Mr. W. H. Hammon, formerly at St. Louis, to be forecaster at San Francisco, and Mr. E. B. Garriott at Washington.

The Secretary of Agriculture sailed for Europe Sept. 4.

Mr. H. J. Cox, in charge at New Haven, has been ordered to Chicago as local forecast official, to assist Prof. W. L. Moore.

Dr. Austin L. MacRae, formerly of the Weather Bureau and later Professor of Electrical Engineering in the School of Mines at Rolla, Mo., has been elected Professor of Physics at the University of Texas, at a salary of $3,000 per year.

A bulletin on Protection of Fruits, Vegetables, and other Food Products from Injury by Heat or Cold during Transportation, has been issued by the Chief of the Weather Bureau.

CORRESPONDENCE.

PERIODICITY IN WEATHER PHENOMENA.

Editor of the American Meteorological Journal:

In February, 1892, I made a list of the dates on which the barometric pressure was relatively high in the United States, from 1888 to 1892. These dates averaged five to six each month. Having tabulated them and counted the recurrences at intervals of 25, 26, 27, and 28 days, I found the 27-day interval to have the maximum number of recurrences, and the 28-day interval the next largest number. This indicated, roughly, a periodicity of between 27 and 28 days, and nearer 27 than 28. Lack of time and facilities for study led me to forego further investigation, but since the publication of Prof. Bigelow's results I have resumed it, particularly for the reason that my results indicated a periodicity of over rather than under 27 days. Returning to a study of the table which I had constructed, with a clew furnished by Dr. Veeder's auroral studies I soon discovered a very apparent periodicity, and by successive approximations obtained the value which I have finally adopted, being 27.271 days. I have not had access to data which would enable me to get a more accurate value, but do not think the probable error of this determination exceeds .001 of a day. It is .007 of a day less than that adopted by Dr. Veeder from his study of auroras, and this difference amounts to a day in 11 years.

I have assumed, arbitrarily, June 1, 1893, as the first day of the period, and made a table showing the day of the period on which any date falls from 1830 to 1894. I then tested the period with various magnetic and meteorological data, and the results appear to justify the conclusion that it is a true period and valuable for purposes of research. The following table illustrates the application of the period to various phenomena. The first column gives the days of the period from 1 to 27, with one additional day for the fraction over 27 in the length of the period.

1. Number of days with high wind velocity on Pike's Peak, from 1874 to 1888. Five to six days in each month were taken, and distributed in the period.

2. Days with large number of thunderstorms in the United States, from 1887 to 1894.

3. Days with excessive daily precipitation. These were taken from the tables in the "Monthly Weather Review" for 1892, and embrace the period from 1871 to 1892.

4. Dates of lowest latitude of storm tracks from the charts in the "Monthly Weather Review" from 1872 to 1894. Only those storms were taken which moved southerly and recurred.

5. Dates of commencement of West India hurricanes. These are as given by Prof. H. A. Hazen in the "Monthly Weather Review" for November, 1893, and include the months of August, September, and October, from 1874 to 1893.

6. Dates of commencement of West India hurricanes from June to December, inclusive, 1871 to 1893. The "Monthly Weather Reviews" were carefully examined and the earliest date mentioned in connection with any storm was used in this table, in some cases being a day or two earlier than that given by Prof. Hazen. A few storms in August, September, and October, in addition to those in the previous table, were included.

9. Days with high barometric pressure in the United States, mainly since 1887.

8. Days with large disturbance of horizontal force at Los Angeles, Cal., from 1883 to 1889. These were days on which the range exceeded a certain limit, as given in a table in the Coast Survey Report for 1892.

9. Sums of daily range of horizontal force at Los Angeles in 1883.

10. Auroras at Cambridge, Mass., 1840 to 1888.

	1	2	3	4	5	6	7	8	9	10
1	**50**	**23**	15	**60**	7	**10**	**38**	8	326	31
2	33	19	17	34	6	5	18	3	260	30
3	**39**	14	15	36	**8**	**11**	**38**	**11**	**339**	**36**
4	35	16	**18**	**58**	5	7	26	5	290	33
5	**41**	19	17	20	**8**	**11**	20	3	260	27
6	38	**20**	**21**	**56**	4	8	23	**7**	**336**	28
7	35	9	13	26	1	0	26	3	246	29
8	**49**	11	16	52	6	**13**	**34**	2	220	**43**
9	**48**	**15**	17	**64**	**8**	**13**	20	**7**	**263**	**43**
10	34	**15**	19	40	6	4	20	2	254	27
11	**46**	13	**27**	47	**10**	**12**	**34**	**7**	244	**37**
12	39	16	14	45	4	6	19	4	346	30
13	35	17	16	**66**	2	1	19	**9**	328	35
14	**45**	**18**	12	48	6	**10**	27	5	**377**	**39**
15	35	12	**20**	43	**7**	7	**32**	4	300	24
16	**51**	**18**	15	48	4	6	23	4	215	37
17	42	**18**	**30**	**58**	3	**8**	22	**5**	267	**39**
18	36	17	21	37	1	2	**36**	4	337	35
19	31	**27**	15	**56**	**7**	**9**	31	**10**	**484**	**44**
20	42	18	20	26	1	1	23	7	359	31
21	**47**	14	**25**	**61**	**5**	**9**	28	5	272	**35**
22	37	**20**	20	57	3	2	**30**	3	**296**	29
23	32	10	11	30	5	6	**31**	8	247	35
24	44	**22**	**16**	**49**	**9**	**13**	17	**11**	352	**38**
25	47	14	11	41	3	5	23	**11**	370	36
26	**51**	**20**	16	**55**	**11**	**13**	**27**	9	**468**	**43**
27	32	16	**18**	43	1	2	22	10	365	42
	7			11	2	2	5	3	98	11

The results show that the days of the period on which maxima fall are the 3d, 6th, 9th, 11th, 14th, 17th, 19th, 21st, 24th, and 26th. The days of minima are the 2d, 5th, 7th, 10th, 12th, 16th, 18th, 20th, 23d, and 25th. Of

the days of maxima, the 9th and 11th and the 26th show the greatest amplitudes. As far as I have been able to trace the period in the early part of this century, the days of maxima and minima are the same as at present.

The close correspondence of this period with that assumed as the synodic period of solar rotation from observations of spots, points to a cosmical or solar origin. The data regarding sunspots, to which I have had access, are very limited, but show slight evidence that the solar spotted area is subject to this periodicity. It would seem, however, that the closeness of correspondence between the two periods is only accidental, inasmuch as Carrington's assumed period is the mean of varying periods of rotation of spots in different latitudes. If there are permanent centres of solar activity, as assumed by some, and apparently confirmed by my results, the spots once formed drift with surface currents, varying in velocity in different latitudes, while fresh outbursts occur at the same localities. The observations of Wilsing on faculæ are likewise confirmatory of this, and the period which he obtained, 25.23 days, or a synodic period of 27.12, does not differ greatly from my period.

For the verification of my results, the ephemeris, as given in the Greenwich volumes, may be used without much error for a period of ten years, the first day corresponding with the 21st of my period at present.

The following tentative conclusions respecting meteorological phenomena on days of maximum intensity appear to be afforded by a study of the results. Cyclones appear in low latitudes, or are developed in the southern extremity of troughs of low pressure; they also attain the most southerly point of their course.

Anticyclones appear in high latitudes, and begin a southeasterly movement. In connection with this it may be stated that the dates of lowest temperature in the Canadian Northwest Provinces, as given in the Canadian *Monthly Weather Review*, fall on these days. A tendency to an increase in condensation and precipitation of moisture is also apparent, and the increase in thunderstorms at the same time is likewise well marked.

It is evident that this period is to be classed with that of Prof. Bigelow, and the coexistence of these periods is an interesting fact, and furnishes a promising field for investigation.

H. W. Clough.

Nashville, Tenn., Aug. 1, 1894.

A METHOD OF VENTILATING THE PSYCHROMETER.

Editor of the American Meteorological Journal:

I should like to suggest what may possibly be a new method of ventilating the psychrometer in the window shelter.

A one inch square wooden upright is fixed in front of and at the right of the maximum and minimum thermometers; and upon this the psychrometer is hung in precisely the same manner as the maximum thermometer. A two-ounce jar filled with water is used to wet the bulb. The instrument is tilted slightly to the left and the jar is moved up to and surrounding the bulb, thus saturating the cover. The first twirl rids the bulb covering of all superfluous water, and a second reduces the mercury to the lowest point. It has never been found necessary to give the instrument more than two twirls; but it must be watched as it comes to a rest the second time, and the reading quickly made, as the mercury sometimes begins immediately to rise on the motion ceasing.

In freezing weather the bulb is moistened some fifteen minutes before the time of observation and allowed to freeze. It then receives the usual two twirls when the reading is made.

It compares very favorably with the ordinary sling psychrometer.

I. H. LEVY.

FRANKLINVILLE, N. J., Aug. 31, 1894.

BIBLIOGRAPHICAL NOTES.

THE RESULTS AND PURPOSES OF TERRESTRIAL MAGNETIC INVESTIGATIONS.

SCHMIDT, A. *Ueber die bisherigen Ergebnisse und die zukünftigen Aufgaben der erdmagnetischen Forschung.* Reprint from "Verhandl. Gesellsch. Deutscher Naturforscher und Aerzte." 8° Nürnberg, 1893. 6 pp.

The above is an abstract of a most excellent address on the results and purposes of terrestrial magnetic investigations, which the reviewer had the good fortune to hear at the Nuremberg meeting (September, 1893) of the German Association of Scientists, corresponding in its aims and purposes to the British Association for the Advancement of Science, and to the American Association for the Advancement of Science.

Dr. Schmidt stands in the front rank of theoretical terrestrial magnetists of to-day, and has made a thorough study of the problem of terrestrial magnetism, both from the theoretical and from the practical standpoint. After giving a brief account of what has already been accomplished in this field, which is more and more drawing the attention of every scientist to it, and to which the astronomer, meteorologist, and geologist must look for the solution of some of his most perplexing problems, the speaker gave a clear and concisive presentation of the needs and purposes of future investigations. The point chiefly insisted upon was the absolute need of such an international organization for the planning and directing of future researches, and for the preserving and the discussing of material collected, as exists to-day in other fields, *e. g.*, astronomy and geology. Without such an international centre the shameful waste of material and energy that prevails to-day will continue to exist. An important point, not mentioned, however, is that terrestrial magnetism must have an organ of communication of its own, and above all struggle and fight for an independent existence of its own, and tear itself loose from the stepmotherly treatment accorded it by other sciences. Then first will it receive the recognition that no true scientist will deny it merits.

L. A. BAUER.

FRIEDENAU BEI BERLIN, Aug. 6, 1894.

TITLES OF RECENT PUBLICATIONS

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(An asterisk [*] indicates that the publications thus designated have been received by the Editor of this JOURNAL.)

BADEN. CENTRALBUREAU FÜR METEOROLOGIE UND HYDROGRAPHIE. *Niederschlagsbeobachtungen der Meteorologischen Stationen im Grossherzogthum Baden.* Jahrg. 1894. Ildu. 2 Halbj. 4to. Karlsruhe, 1894. 25, 25 pp.

DAWSON, W. BELL. *Survey of the tides and currents in Canadian waters.* 8vo. Ottawa, 1894. 14 pp.

HAMBURG. DEUTSCHE SEEWARTE. *Sechzehnter Jahresbericht ueber die Thaetigkeit der Deutschen Seewarte fuer das Jahr 1893.* [Beiheft I zu den "Annalen der Hydrographie und Maritimen Meteorologie." 1894]. 8vo. Hamburg, 1894. iv, 60 pp.

INDIA. REVENUE AND AGRICULTURAL DEPARTMENT. *Memorandum of the snowfall in the mountain districts bordering northern India, and the abnormal features of the weather in India during the past five months, with a forecast of the probable character of the southwest monsoon rains of 1894.* Fol. Simla, June, 1894. 22 pp.

*KAZAN. L'UNIVERSITÉ IMPÉRIALE. *Observations, faites a l' Observatoire Météorologique de l' Université Impériale de Kazan.* Jan.–Avril, 1894. 8vo. Kazan, 1894. 18 pp.

*NEW JERSEY WEATHER SERVICE. *Fourth annual report of the Board of Directors.* 1893. 8vo. Trenton, 1894. 303 pp. 4 ch.

*NORTH DAKOTA WEATHER SERVICE. *First annual report for 1893.* B. H. Bronson, Observer, Weather Bureau, Director. 8vo. Grand Forks, N. D., 1894. 70 pp.

NORTHWESTERN PROVINCES. INDIA. *Brief sketch of the meteorology of the Northwestern Provinces and Oudh and adjacent parts of Rajputana and the Punjab for the year 1893.* Fol. (Allahabad, 1894.) 7 pp.

*U. S. HYDROGRAPHIC OFFICE. *Pilot Chart of the North Atlantic Ocean,* August, 1894. With supplement showing tracks of storms during the months of August, September, and October, for the period of six years, 1888 to 1893 inclusive. 2 charts, 24x34 in. Wash., 1894.